HYDROLOGIC PROCESSES DETERMINING POREWATER SALINITY IN A SOUTHEASTERN SALT MARSH

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Coastal wetlands provide many important ecosystem services, which include carbon and nitrogen sequestration and transformations, the provision of habitats, and the reduction of erosion by the vegetation. In coastal marsh ecosystems, porewater salinity strongly determines vegetation distribution and productivity. Therefore, as part of the Georgia Coastal Ecosystems Long Term Ecological Research project, an integrated modeling approach has been developed and applied to the Duplin River marsh, Sapelo Island, Georgia, which simulates porewater salinity and water content distributions in surface sediments across the entire Duplin River marsh domain. The development of the soil model is presented, which is based on mass conservation for water and salt and links physical, hydrological, and biological processes that determine porewater salinity, including precipitation, evapotranspiration, salt exchange between surface and subsurface, groundwater exchange, and tidal inundation, with the lateral exchange controlled by marsh topography. Model validation is performed by comparing model-estimated salinities to porewater salinity measurements of the same vegetation class and marsh elevation. To identify the environmental factors that control marsh salinities, a sensitivity analysis was carried out that assesses the effect of precipitation intensity, evapotranspiration, hydraulic conductivity, salt exchange, tidal salinity, and marsh elevation have on porewater salinities. Also, model-derived variability in porewater salinities was quantified over seasonal and interannual time scales, accounting for drought, normal conditions and years with excess rain. Annual simulations and the sensitivity analysis reveal that vegetation classes can be split up into two groups, low marsh plants—short, medium, and tall Spartina alterniflora—and high marsh plants—Borrichia frutescens, Batis maritima, Juncus roemerianus, and Sarcocornia spp. Initial results show that low marsh porewater salinity in our study region is sensitive to changes in the salinity of the flooding tide, which is strongly correlated with Altamaha River flow, whereas the high marsh is sensitive to changes in precipitation and evapotranspiration.

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